GSM network solutions for new-growth markets

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The global number of mobile subscriptions is predicted to grow from 1.3 billion as of January 1, 2004 to more than 2.2 billion by the end 2008. Most of this growth will occur in emerging new-growth markets, which will drive penetration among the low-spending subscriber segment.

Two key technologies will cater for this subscriber growth: GSM (and its evolution to WCDMA) and CDMA. This focus of this article is on GSM technology, which has been deployed in every major market except Japan and Korea, has a strong market position with extensive availability of low-cost mobile terminals, and has an evolution path to increased capacity and faster data services.

The emphasis in new-growth markets is on increasing subscriber penetration, in particular, the segment of population which could not previously afford mobile telephony services or which lived outside of areas with mobile coverage.

Subscriber penetration in many "mature" markets is now saturated. So instead of focusing on growth in these markets, the main emphasis is on increasing revenue per subscriber by introducing advanced features and services.

This article describes the operator challenges and gives an in-depth description of how Ericsson's Expander Radio Coverage solutions can support operators when expanding into new, untapped markets.

Market characteristics

New-growth markets have several common characteristics: cost of capital is high, and a generally low gross domestic product (GDP) implies a high potential base of low-income customers. Despite government efforts to create sustainable rural cities, population growth in these markets is primarily concentrated to mega-cities.

Because the new-growth markets are cash economies, the most prevalent type of mobile subscription is prepaid. Some markets have only recently been deregulated, which means basic utilities and communications infrastructures are often lacking or based on aging technology. In some cases, the users have no previous experience of telephony. However, this does not mean that they are satisfied using dated technical solutions when services are introduced.

Analysts predict that the number of mobile subscribers in these markets will double between 2004 and 2008. Likewise, mobile traffic, they say, will more than double over the same period. Tariffs in these markets are often high, which leads to low penetration with relatively high average revenue per user (ARPU). In most markets, however, competition—often in combination with number portability—will drive tariffs down. Statistics show that thanks to the related subscriber growth, operators can maintain or even increase profitability as tariffs fall. One of the most important enablers of growth is the availability of low-cost terminals.

Today's operators have an opportunity to tap into this potential by deploying cost-effective coverage and capacity solutions. By adopting future-proof technology, they will also be able to meet the evolving demands of new subscribers. Existing operators, with established footprint and networks, are best positioned to acquire new subscribers. They can spread their costs and draw on economies of scope and scale. Although the current focus is on subscriber growth, these new subscribers also represent growing per-customer traffic and spending—after all, today's new users are the advanced users of tomorrow.

Operator challenges

Operators face several challenges in addressing new-growth markets. These challenges affect every area of operations and include business-, network-, and capital-related expenditures.

Subscriber acquisition

A substantial part of business operations focuses on signing up new subscribers. And perhaps the biggest obstacle is a lack of low-cost terminals. Another challenge in some markets is the perception that mobile phones are a luxury item—indeed, some countries apply luxury tax to mobile phones, which further inflates prices.

Charging and managing credit risk

Obviously, to generate revenues and positive margins, operators must be able to man-

BOX A, TERMS AND ABBREVIATIONS

BSS	Base station subsystem	OL	Overlay
CAPEX	Capital expenditure	OPEX	Operating expenditure
CDMA	Cell-division multiple access	OSS-RC	Operations support system—radio and core
CDU	Combining and distribution unit	RAN	Radio access network
dTRU	Double TRU	RBS	Radio base station
EDGE	Enhanced data rates for global evolution	RX	Receiver
GDP	Gross domestic product	SMS	Short message service
GPRS	General packet radio service	TCC	Transmitter coherent combining
GSM	Global solution for mobile communications	TRU	Transceiver unit
KPI	Key performance indicator	TRX	Transceiver
MTBF	Mean time between failures	UL	Underlay
O&M	Operation and maintenance	WCDMA	Wideband CDMA

age credit risk and prevent revenue leakage. Also, to compensate for expected low revenues per customer, they must have large volumes of subscribers. In practice, this means prepaid services for the vast majority of users, and a real-time charging system to prevent credit overruns. To minimize churn, operators must also consider what level of prepaid card denomination best encourages users to refill and retain their subscriptions. User spending control is also important, because it is doubtful that users can deal with unexpectedly large bills at the end of the month.

Distribution channels

Giving people convenient and simple ways of refilling their subscriptions is essential. High-cost refills and a lack of dealers and refill channels are barriers to usage. Starter packs should be promoted and made available through many channels. This is more easily accomplished with prepaid or hybrid packages than with post-paid subscriptions. Prepaid offerings are easier to distribute, sign up and activate because they do not necessitate contracts or credit checks.

Service differentiation

Service differentiation, which is about providing the right services to the right segments, plays a vital role in attracting first-time users and profitably addressing new subscriber segments with lower spending levels. The service mix can be used as a differentiating factor, but the services themselves must never skimp on quality. Operators who use voice quality and grade of service as differentiators risk greater churn.

Radio network infrastructure

Many new-growth markets face two fundamental network-related challenges. These are a lack of radio coverage in rural areas, and the need for greater capacity in densely populated areas. Other challenges arising from serving a low-income customer base include lack of financing for new technology, and excessive competition, which erodes profit margins. The challenge is to adjust the cost structure needed to acquire necessary features and functionality while remaining profitable at subscriber spending levels of less than USD 5 per month. This means low production cost per minute of use (MoU) and high utilization of network resources. Network equipment typically accounts for the largest share of capital expenditures (CAPEX)—some 50 to 80 percent of a mobile operator's CAPEX is network-related. For operators in new-growth markets, radio access makes up the biggest part of investments in network infrastructure.

There are, however, many interdependencies between operating expenditures (OPEX) and capital expenditures, and in some cases it is possible to reduce OPEX through capital investments. Investing in better-quality base station equipment and flexible base station subsystem (BSS) features, for example, can give better coverage and reduce the total number of sites. Reducing the base station footprint can help cut site rental costs; more advanced base stations can reduce power consumption[1]; and improved in-service performance can result in fewer site visits.

Transmission flexibility

Most new-growth market subscribers reside in large cities where greater capacity is the primary issue. In rural areas, however, the need is not for capacity but rather for transmission and radio coverage. New network architecture and equipment packages are thus needed to deliver cost-effective coverage quickly. The cost of building a transmission network usually accounts for half of the total network investment. Therefore, it often pays to lease transmission during the first years of operation.

Network complexity

Many operators who are targeting new-growth markets will have to recruit or train personnel to run their networks. Existing operators might already have advanced networks based on dual-band, general packet radio service (GPRS) and service networks that offer a competitive portfolio of services. But they will still need to enhance traffic capacity in urban areas and plan and build out coverage in new regions. To reach the full potential of traffic capacity from existing infrastructure (radio sites and available spectrum), they will need advanced radio features, and they might need help implementing them. Unless operators are able to reuse existing radio sites, the only way forward will be to obtain more spectrum or to increase radio network density by adding more and smaller sites. For many operators, however, these options are not feasible. Instead, they need strong sets of advanced features and built-in system functionality to help guide personnel when planning and running their networks.

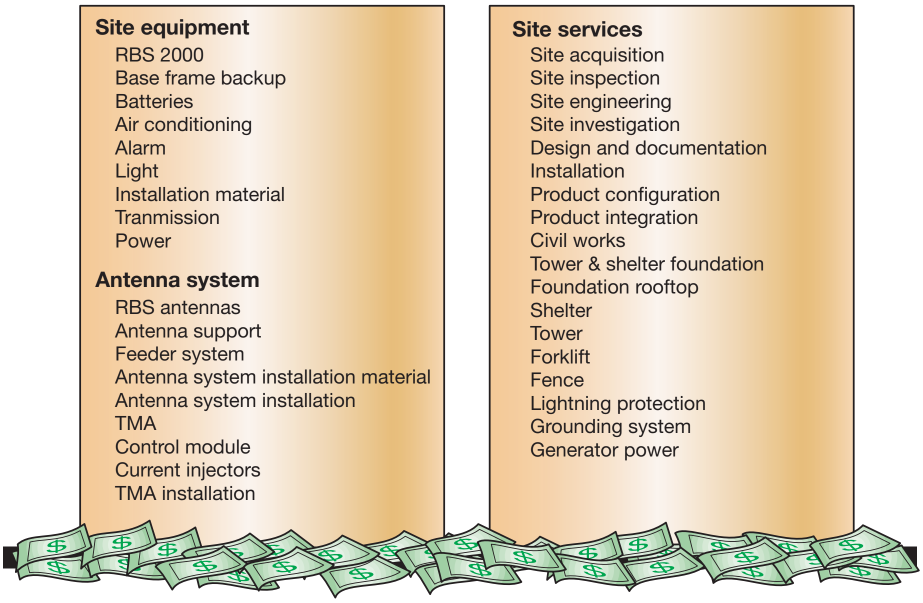


Figure 1
Examples of CAPEX items for an RBS site.

The deployment of traffic in new areas is often related to the placement of radio sites in remote areas. Some sites can only be accessed through many days of hard traveling. Obviously, this is undesirable. Operators thus want to reduce the number of sites needed to provide coverage. They also want more reliable equipment. Finally, they want radio sites that are easy to understand and work on. That way, less technically qualified personnel can, if necessary, be sent to sites to perform simple tasks.

In addition to network expansions, which increase network complexity, wireless data infrastructure will become more important for new-growth markets—in particular because GPRS-based services open the door to significantly lower voice tariffs. Ericsson Instant Talk services, which will enable affordable group voice communication, will likely be as successful in these new markets as short message service (SMS).[2] The infrastructure will be based on GPRS, which heightens the requirements for planning and running wireless end-to-end data services.

Network rollout and tuning

A lack of skilled labor is often a limiting factor when operators want rapid rollout. Notwithstanding, to achieve maximum capacity and coverage on a limited budget, operators must pay careful attention to radio network tuning. By hiring in experienced crews, they can substantially shorten this slow and tedious process.

Advanced radio network functions that facilitate radio network planning and improve network performance are also important parts of the process. For example, four-way receiver diversity greatly increases sensitivity in base station uplinks, thus improving coverage characteristics. Similarly, advanced analysis and reporting functions available via the operations support system—radio and core (OSS-RC) present network information in a format that is easily understood by operation and maintenance (O&M) staff.

Radio site solutions

Standard site configurations are often used to simplify network rollout. The sites can be assembled in a factory environment or on site. In either case, efficient supply flow is needed to deliver all necessary materials on time. Given the cost structure of new-growth markets, the most cost-effective way of building a site generally makes use of local suppliers and certified local subcontractors.

Managed services

Many operators in new-growth markets have limited experience of handling mobile

network management and growth. They might therefore benefit from different kinds of managed services. This could be limited to hosting complex nodes—for example, for MMS—but, for good reason, there is a growing trend to outsource entire network operations.

The ultimate outsourcing model—where a supplier delivers capacity as specified by a number of key performance indicators (KPI)—is now taking form in some markets. Here, the network is built out at a pace determined by actual traffic growth. The model addresses financing and competence, and is likely to grow in importance in coming years. It also allows operators to focus on their core business, which is to deliver competitive subscriber services.

Low-cost radio networks for rural coverage

Different solutions for different segments

The main objective of running a telecommunications business is to make money. Consequently, when it comes to service offerings, it frequently pays to stay ahead of local competition. Most markets have more than one mobile operator, and because the majority of users have prepaid subscriptions it is usually quite easy for them to switch operators. New subscribers generally fall into two segments: those who reside in

- urban and suburban areas, where coverage is already in place. The challenge to add more subscribers is often limited by available radio spectrum. The GSM radio networks in this segment are *interference-limited*; and
- rural areas, where traffic demand is unknown because coverage does not currently exist. Operators must thus take commercial risk, investing in infrastructure without knowing when it will pay off. The GSM radio networks in this segment are *coverage-limited*.

The radio features of Ericsson's advanced base station subsystem (BSS) offer a solution for the former segment—that is, the segment with interference-limited systems. Getting more traffic into limited radio spectrum requires sophisticated functions enabled by a rich portfolio of advanced radio features and solutions that allow more carriers (transceivers, TRX) to be inserted into radio networks without jeopardizing the perceived radio quality.

Available solutions for gaining more capacity through cell-, network-, and channel-capacity solutions were described in Ericsson's GSM RAN capacity solutions.[3] Ericsson leads the industry when it comes to solutions for optimizing the use of capacity in existing spectrum.

Smaller cities, villages, and sparsely populated areas make up the rural-area segment, which requires efficient radio solutions with a minimum of radio base station (RBS) sites. A common fallacy is that to minimize the risk of business investments in rural areas, operators should only consider low-priced equipment.

Cost structure of the RAN

Network equipment typically accounts for the largest share of capital expenditures. About 50 to 80% of a mobile operator's capital expenditures is related to networks. For most operators, radio access takes the lion's share of the infrastructure budget. The cost structure of the radio access network (RAN) is usually divided into

- CAPEX, which covers all costs related to initial investments; and
- OPEX, which covers the annual cost of running the network.

The CAPEX for a typical RBS site consists of many elements. The costs associated with an RBS are just part of the total cost that an operator must pay for a new site installation (Figure 1). The price of RBS equipment is only a fraction of the total site cost. But many operators do not readily see that in addition to equipment they will have to pay for services and work carried out by their own organizations or outside help.

Local market conditions affect the actual price of site materials and services. When considering the total cost of infrastructure investments, most expenditures relate to radio network infrastructure. Breaking this down in greater detail, we see that the actual cost of the RBS is only about one-third of the total investment in infrastructure—indeed, most expenditures relate to site materials and services (Figure 2).

Operating expenditures are another large financial item that covers all the costs of operating RBS sites in networks. Many costs are easy to forecast because they are based on givens such as set prices for energy and power, transmission, and site rental. Operating expenditures also include maintenance costs relating to

- manual intervention at sites (for example, replacing batteries, adjusting air condi-

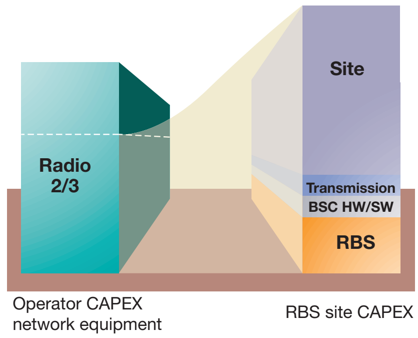


Figure 2
Cost structure for operator's infrastructures.

tioners, and eliminating transmission failures); and
- unplanned site visits to correct faulty equipment—this expense is hard to nail down because visits can involve salaried employees, travel time, and equipment (car rental and spare parts).

It goes without saying that better, more reliable RBS equipment reduces these costs.

Fulfilling customer demands for lower OPEX

Ericsson knows that its customers want more robust RBS equipment. Therefore, it has developed the second generation of the RBS 2000 family. In doing so, Ericsson reduced the number of replaceable units by 50% while maintaining reliability per unit. These enhancements were made possible thanks to a new hardware platform that facilitates greater integration. The most important element in this new platform is the double transceiver unit (dTRU) that is a transceiver unit which contains two complete GSM transceivers.

Reliability measurements

The most advanced unit inside an RBS is the transceiver. It contains
- powerful amplifiers for transmitting strong radio signals;
- sophisticated processing capability for radio reception; and
- advanced features for handling traffic.

Using a high degree of integration, Ericsson has been able to maintain the same level of reliability from its dTRU as from the previous TRU (with one TRX).

The main objective of the design was to improve the reliability of RBS configurations. To determine how the number of units affects the service levels (reliability) of a large population, Ericsson compared the reliability of systems built with different types of units with the same MTBF value. Figure 3 compares two TRXs in a replaceable dTRU and one TRX in a replaceable dTRU.

Most operators have several RBS installations in their network. Assuming that every reported fault on the radio must be treated immediately, it is easy to see the advantages of having more reliable products in the field. Figure 4 illustrates the potential savings of using more robust radio equipment for medium-sized configurations.

The best ways of achieving cost-effective deployment of a radio network are to reduce the number of required sites and to invest in RBSs that require less maintenance. In some situations it might be beneficial to employ low-capacity RBS solutions, for example, where the terrain prevents the deployment of large radio cells or where the demand for capacity is low and is not expected to change in the near future. Through its Expander program, Ericsson has introduced new capabilities for existing RBS models and new RBS models that better meet operator deployment strategies. The same hardware platform has been used in each model. To the operator, this translates into reduced OPEX (more reliable RBS equipment) and reduced CAPEX (fewer sites and fewer spare parts).

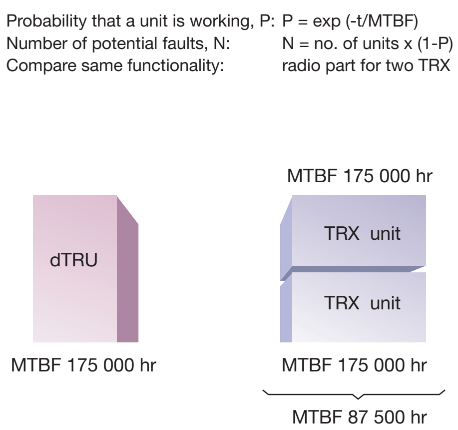
Solutions for fewer RBS sites

The best route for deploying RBSs in new areas where traffic demand is unknown is to deploy thin but continuous radio coverage via high-performance radio. With two TRXs in each dTRU, the new architecture of the RBS 2000 facilitates additional enhancements to radio performance. Note: When planning a radio network that uses dTRUs, operators should consider the RBS
- downlink capabilities—for reaching the phone; and
- uplink capabilities—for receiving weak signals from the phone.

Three downlink enablers

The dTRU contains two TRXs and an internal hybrid combiner that combines the transmitter signals from the TRXs. The TRXs thus share a common outlet that is fed to the combiner and antenna system. This solution supports four TRXs per antenna.

Figure 3
MTBF reduction when number of units is increased.



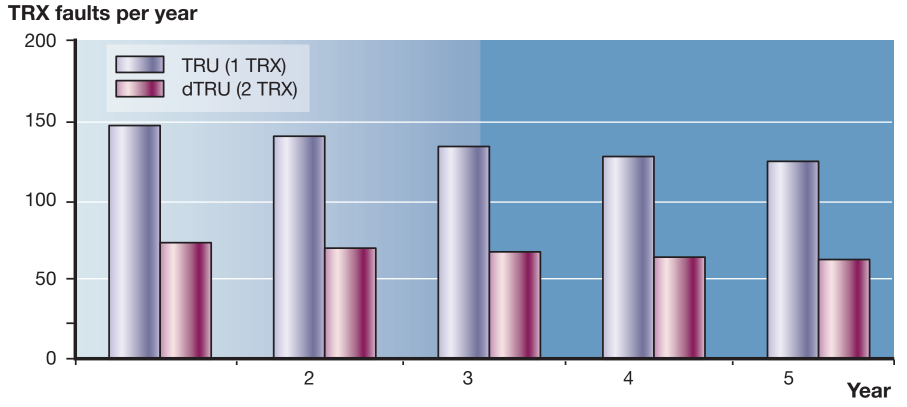


Figure 4
Reliable hardware reduces the number of site visits. This example reflects an installed base of 500 RBSs with six TRXs in each cabinet.

If greater output power is preferred—for example, to provide greater coverage—each TRX can instead be connected directly to the combining and distribution unit (CDU) for connection to the antenna system. This limits the number of TRXs that can be installed in a cabinet, due to the fixed number of inlets to the CDU (if the internal hybrid in the dTRU is not used, only one TRX can be used per CDU inlet). This solution provides greater output power and enables operators to build larger cell areas, which cuts down on the number of RBS sites needed to cover a specific region.

Transmitter coherent combining (TCC) is a software solution that improves the downlink. The solution combines intelligent use of phase adjustment with the internal hybrid combiner (Figure 5). When the dTRU runs in TCC mode, it continues to operate in its normal environment—that is, it does not generate extra heat that might affect the reliability of the dTRU or other equipment in the cabinet.

The three downlink enablers mentioned above use the same equipment or dTRU. The only significant difference is the way in which the transmitter (TX) cables are attached when the internal hybrid combiner in the dTRU is not used. Ericsson also offers a fourth option (available since 1997) for enhancing the downlink. The software power boost function supports downlink transmitter diversity (the mobile phone combines the best of two signals) by transmitting the same information on two TRXs with a short delay and different antennas. Compared with TCC, transmit diversity has

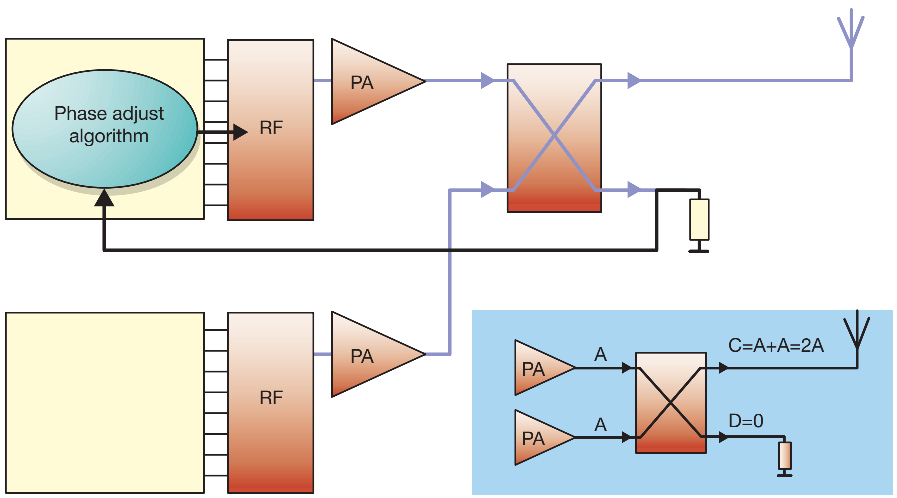
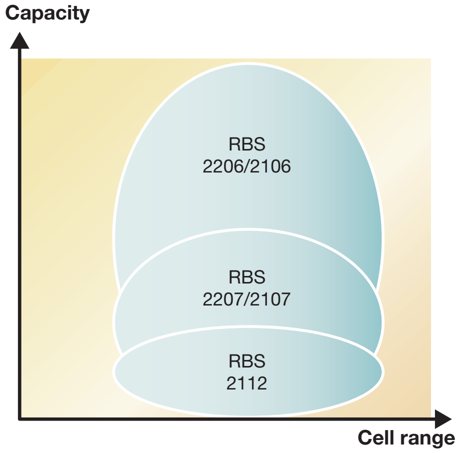


Figure 5
The TCC concept.

Figure 6
Macro RBS enhancements to meet operator requirements for investing in low-traffic areas. New radio capabilities (TCC, 4-RX diversity, and smart range configurations) reduce the number of radio sites. Likewise, the addition of new outdoor RBS products—RBS 2107 (6 TRXs) and RBS 2112 (2 TRXs)— gives operators greater flexibility.



some negative implications when the mobile phone must decode eight phase shift keying (8-PSK) modulation for EDGE. Likewise, terrain-dependent conditions reduce the certainty of cell coverage.

In summary, in terms of coverage and greater data throughput with EDGE, TCC is preferred over transmit diversity for enhancing the downlink. Box B and Figure 6 summarize the recommended options that make use of the latest hardware platform.

One other important factor to consider when planning a balanced system is the uplink. The uplink capability is more difficult to measure and verify. This is because the measurement requires sophisticated testing that can only be carried out in laboratory environments.

Ericsson's new hardware platform offers some significant improvements in signal reception from mobile phones—for example, improved control over the receiver path in the chain from antenna to extracted signal.

Besides improved receiver path, operators benefit from additional power for processing a more advanced diversity algorithm—given the availability of the new algorithm and platform, Ericsson recommends that operators use a greater value for diversity gain. Operators may also use all four RX branches in one dTRU to improve the uplink from a single source—this is called four-branch diversity. Regular two-branch diversity can yield an additional 4 to 5 dB in gain. By comparison, depending on how the antennas are arranged, four-branch diversity can yield an additional 7 to 9 dB in gain.

Ericsson provides values for normal network conditions and guarantees the values for radio channels that represent real conditions. Different dynamic channels, or faded channels, are used to communicate real performance values. If static values are to be used, the values can be enhanced by an additional 1-2 dB. Ericsson wants to provide operators with accurate values that can be used when planning radio networks. This is why Ericsson provides dynamic, fading-model values.

Good receiver capability cannot be underestimated. At present, many handsets are designed to have the lowest possible output power. This results in longer standby time, which is an attractive feature to end-users. Notwithstanding, it puts even greater demands on the uplink—for reaching a balanced-link budget and guaranteeing coverage in the radio cell. To achieve good radio quality, which is a prerequisite for offering good subscriber services, operators would thus be wise to consider the mobile phone population in their networks. Figure 8 summarizes the different uplink enablers.

The dTRU is very flexible and can be used for several purposes (Figure 9). Its two TRXs, for instance, can be used separately or, by combining Ericsson's unique TCC to improve the downlink and four-way diversity to improve the uplink, they can be configured to create a "super TRX".

Flexible configurations

The downlink- and uplink-enabler solutions can be combined in the same cabinet to offer very attractive combinations of solutions for broad coverage (strong downlink) and high capacity (many TRXs per cell). Ericsson's RBS 2206 (indoor) and RBS 2106 (outdoor) cabinets contain six dTRUs per cabinet.

Having the same equipment in different versions of the RBS gives operators greater flexibility in finding and applying the most

BOX B, COVERAGE ENABLERS

DOWNLINK ENABLERS	
Same dTRU can be used in different configurations	
Combined mode (internal hybrid in dTRU)	42.0 dBm
Uncombined mode	45.5 dBm
Transmitter coherent combining (TCC)	48.0 dBm
Transmitter diversity (software power boost, SWPB)	
Not recommended for extending cell range due to environmental dependencies at cell border	
EDGE (8-PSK) performs worse with TX diversity than with TCC	
UPLINK ENABLERS	
Receiver sensitivity without TMA	-111.0 dBm
Receiver sensitivity with TMA (+compensation for feeder loss)	-111.5 dBm
Two-branch RX-diversity, urban/suburban	4.5 dB
Two-branch RX-diversity, rural	3.5 dB
Four-branch RX-diversity	7-9 dB

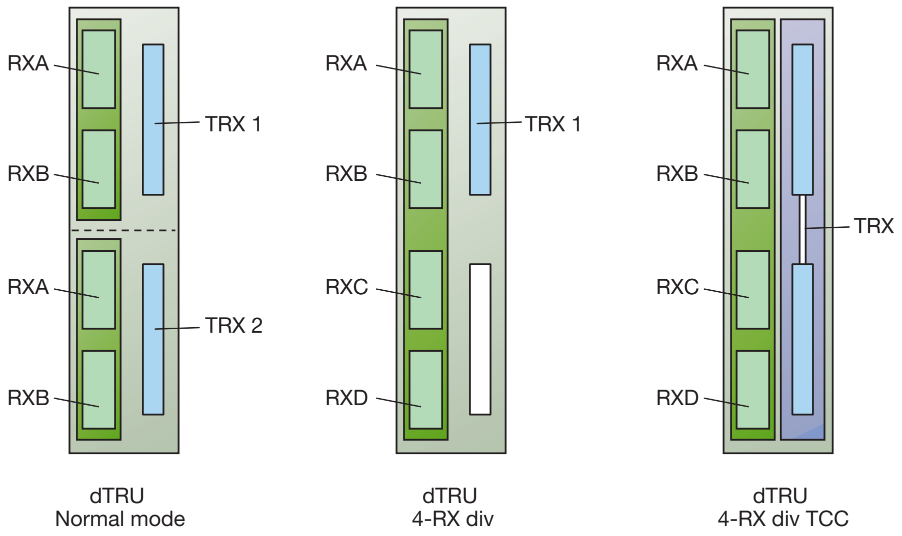


Figure 7
One dTRU can easily be used to extend coverage.

appropriate configuration. For example, a common configuration might have four TRXs per cell (4+4+4 configuration). Six dTRUs are configured using the internal hybrid in the dTRU. The configuration is also called *capacity mode*, because emphasis is on providing as many TRXs as possible per antenna.

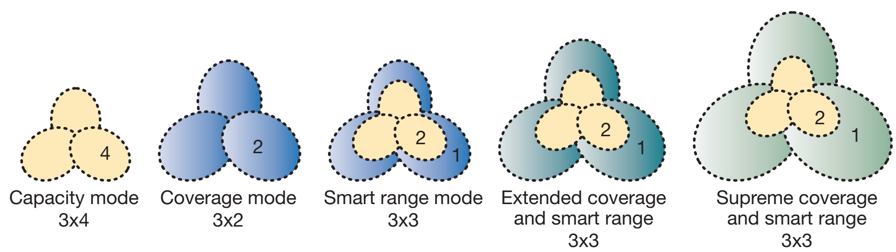
One other configuration, 2+2+2 or *coverage mode*, yields greater output power by not using the internal hybrid in the dTRU. The CDU inlet solely permits three dTRUs to be inserted in the cabinet.

By combining dTRUs configured both with and without the internal combiner, operators can obtain a combined capacity mode and coverage mode configuration in the same cell. This configuration retains the coverage provided by high-output-power TRXs and adds extra capacity by using two additional TRXs with lower output power. A traffic-steering feature manages the differences in the cell range by moving end-users to the smaller overlay subcell when appropriate. This frees up capacity in the larger underlay subcell, which, in turn, yields a total of three TRXs per cell. What is more, the 3+3+3 configuration fits in one RBS cabinet. This approach of combining different output power in the same cell is called the *smart range configuration*.

By boosting the cell range of the underlay subcell, operators can also share the combination of larger subcells (greater coverage) and smaller subcells (greater capacity) with other mechanisms for enhancing coverage. They can also use TCC and run one dTRU as a more powerful TRX. In this case, the same set of cabling is used as for the capacity-mode configuration. The capability is activated with a software command from the BSS. Because the downlink has been extended, this solution gives greater coverage—*extended coverage mode*—than the coverage-mode configuration.

Even better coverage can be obtained when the dTRU is run in combination with the TCC concept and advanced, four-branch-receiver diversity in the uplink. This combination is called *supreme coverage mode*, because the combination offers outstanding radio coverage performance. Figure 11 summarizes the configurations that can be provided in one cabinet.

Figure 8
Example of flexibility provided by the RBS 2x06.



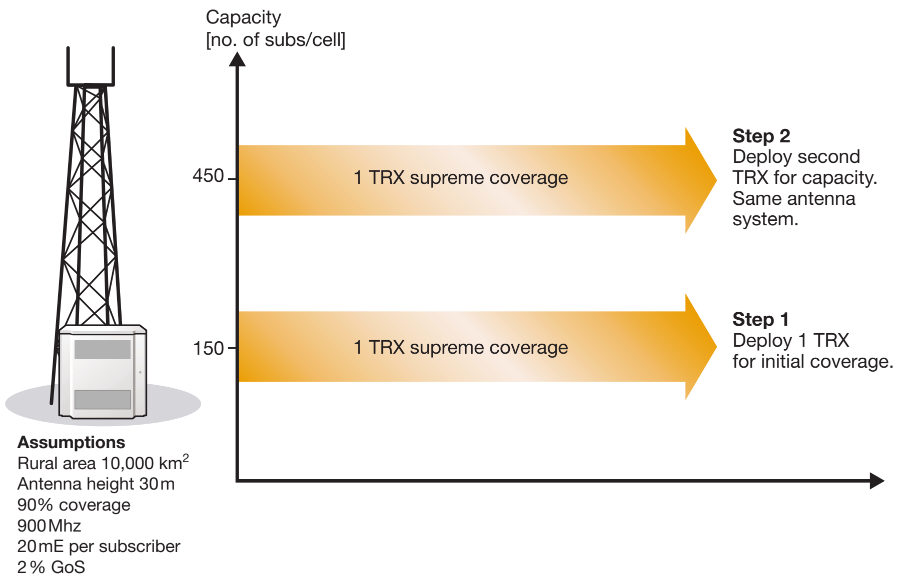
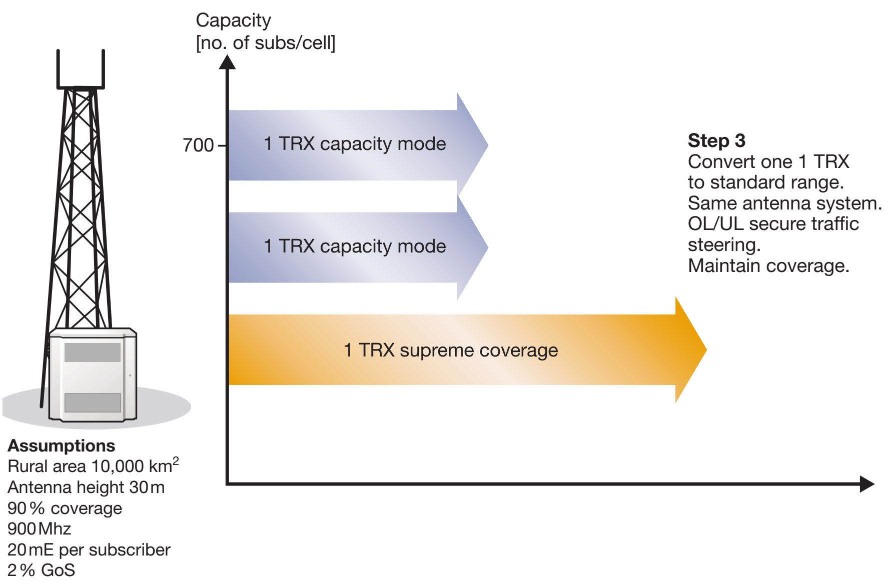


Figure 9
Initial deployment with one TRX per cell and expanded to two TRXs per cell.

Figure 10
Third stage of capacity expansion.



Entry-level solution with potential for greater capacity

Below follows a scenario in which an operator begins deploying large, limited-capacity cells. Later, when traffic increases, more capacity can be added. The sequence (Steps 1-4, Figures 9-11) shows how an initial, extreme-coverage site is expanded to yield ten times as much capacity per cell through the addition of TRX hardware and BSS software features. By employing different configurations of the same set of RBS equipment, Ericsson can help operators to continually optimize their radio networks using a minimum of sites. If conditions are right, large areas can be covered using a single RBS.

Step 1

Ericsson's unique dTRU can be configured as a single TRX with double output power. This reduces the initial investment while providing maximum coverage from a minimum of sites. The solution can be further enhanced with four-RX diversity in the uplink.

Step 2

Capacity is enhanced by inserting an additional dTRU per cell—doing so almost triples the capacity for serving regular subscribers. The antenna and feeder system need not be upgraded (Figure 9).

Step 3

Capacity can be further enhanced without a visit to the site: from the operations center, the second dTRU is put into the capacity-mode configuration, making three TRXs available per cell. Capacity is now up to five times that of the initial configuration. Additional BSS features—dynamic overload (OL) and underload (UL)—are also introduced to secure traffic routing between two subcells with different coverage (Figure 10).

Step 4

Once again, capacity can be increased without a visit to the site. After completing this step, capacity will be 10 times that of the initial configuration. Ericsson's unique, load-based, dynamic half-rate function allocates traffic channels at operator-defined thresholds. The function enables two users to share a single available radio channel in the same cell. If necessary—for instance, during peak hours—every connection

might make use of the half-rate function (Figure 11).

When traffic demand skyrockets, operators can either add

- macro RBS capacity, by deploying additional RBS cabinets at each site and synchronizing them with existing cabinets; or
- micro RBS capacity to offload cells, by introducing micro cells in macro cells.

When this decision comes, however, it will be based on steady traffic demands in the region. That is, the operator is no longer faced with having to invest in a region with unknown traffic volumes. All subsequent expansion with new RBS cabinets will thus be based on healthy traffic scenarios. This means it is fairly easy to calculate when the investment will pay off.

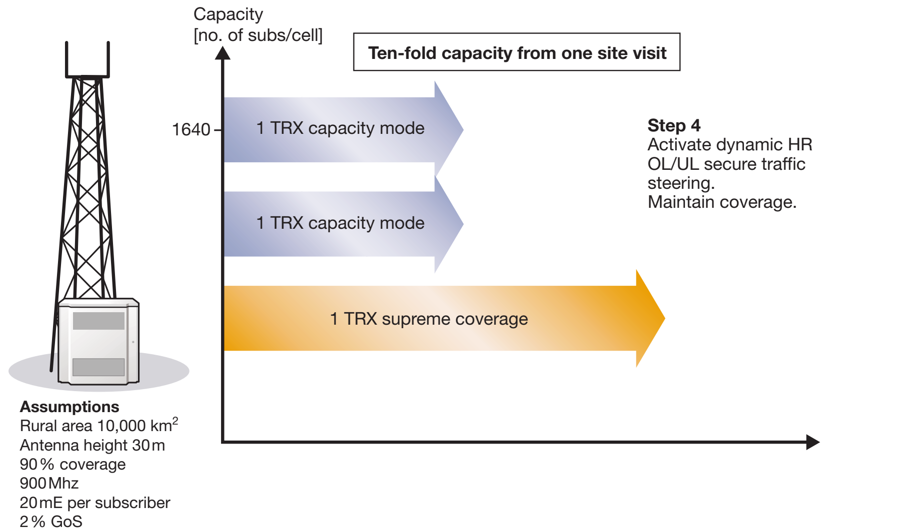


Figure 11
Stage four: Ten-fold capacity per cell in the same RBS cabinet and from the same antenna system.

Conclusion

As-yet untapped new-growth markets offer significant opportunities for growth and expansion provided they are addressed properly. Competition and price pressure in these markets are fierce, marketing costs and churn rates are high, and initially, there will be little demand for value-added services. Typical characteristics of these markets are a low-income subscriber base, limited financing for new technology, and competition-eroding margins. Operator inexperience is also an issue in some areas. Notwithstanding, knowing that new subscriber growth will primarily come from these markets, Ericsson is giving its highest priority to all related requirements.

Ericsson's GSM Expander program, for example, has been developed with these unique requirements in mind. In short, it helps operators to address the challenges of new-growth markets by

- limiting entry-level investments;
- providing flexible and scalable capacity;
- minimizing the total cost of ownership; and
- protecting investments through high-quality technology platforms.

The solutions are reliable and open-ended, which means no compromises are made in performance or quality. Initially, operators might opt to offer a limited amount of services, capacity and functionality, but they are free to expand them later without costly re-engineering.

Ericsson's leadership in the wireless industry maximizes operator business advantages today and provides a secure route toward future capabilities. The Ericsson Expander offering yields different capacity solutions from the same equipment—this lowers operator investment risks, because an RBS and all its parts, for example, are the same regardless of whether they are deployed in urban or suburban areas with heavy traffic or in sparsely populated areas where traffic loads are unknown.

In markets with a large population of prepaid subscribers, competitive operators need to offer the best services in the region. Ericsson's solutions extend cell range without jeopardizing system reliability. No external boosters are needed to improve downlink capability, because operators use the equipment in normal operation mode. This yields better reliability and helps operators to reduce the number of site visits.

To lower business risks, operators need to know that returns on current investments will extend far into the future. Ericsson's large-coverage solution provides a very flexible way of adding capacity as traffic demands increase. This article describes how operators who deploy an RBS site to obtain initial coverage can later boost capacity ten-fold through one visit to the site to insert a second dTRU.

Small-capacity macro RBSs are also available as a complement to the portfolio.

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